ANALYSIS OF THE DYNAMICS OF COUPLED OSCILLATOR ARRAYS FOR ARRAY BEAMSTEERING

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It has been shown both theoreticall y and experimentally that a linear array of oscillators coupled appropriately to each other can be used to control the phase distribution in the aperture of a phased array antenna in a simple and convenient manner. [R. A. York, IEEE Trans., MTT-41, pp.1799-1809][P. Liao and R. A. York, IEEE Trans., &lTT-41, pp. 1810- 1815] One can steer the beam by tuning the oscillators at the ends of the array. It has further been shown that the steady state behavior of such oscillator arrays can be approximately described by Poisson's equation leading to an electrostatics analog in which the oscillator tuning plays the role of charge and the aperture phase is analogous to electrostatic potential. [R. J. Pogorzelski and R. A. York, IEEE AP-S Symposium Digest, Montreal, Canada, July 1997, pp. 324-327.] This analog is based on a continuum model of the array wherein the number of oscillators approaches infinity.

In the present work we use the eontiuum model to study the dynamic behavior of the oscillator array when an injection signal having a time dependent frequency is applied for modulation purposes. We have found that the time dependent behavior of the array is governed by a Schroedinger type equation in which the potential is determined by the injection signal. We have solved this equation in the case of an injection signal applied to the center oscillator of both infinite length and finite length arrays. In the present case the injection signal frequency is a step function but other functions can be accommodated within the theory. With the step function frequency, the solution for the infinite array has the property that the frequency of each of the oscillators approaches the injection frequency as time approaches infinity but the phase deviation from that of the injection signal increases without limit. In the case of the finite array, however, both the frequency and phase reach steady state values. Moreover, the steady state phase distribution is consistent with the results previously obtained using Poisson's equation.

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Paper/Proposal Title:

ANALYSIS OF THE DYNAMICS OF COUPLED
OSCILLATOR ARRAYS FOR ARRAY
BEAM STEERING

☐ Refereed Paper

  ☐ Full Paper

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E'Conference Paper

❏ Trade Magazine
   Article/Newsletter

❏ Proposal

Author(s): R. J. POGORZELSKI AND R. A. YORK

Recommended Action:

☑ **Submit** as **is.**

❏ Modify as suggested.

❏ Not to be submitted at this time.

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ANNOUNCEMENT AND CALL FOR PAPERS
National Radio Science Meeting
January 5-9, 1998
University of Colorado at Boulder, Boulder, Colorado

Web Address: http://cires.colorado. edu/ursi/rfp.html

This open scientific meeting is sponsored by the U.S. National Committee for the International Union of Radio Science (URSI). It is being held in cooperation with the following IEEE organizations: Antennas and Propagation Society and its Wave Propagation Standards Committee, Circuits and Systems Society, Communications Society, Electromagnetic Compatibility Society, Geoscience and Remote Sensing Society, Information Theory Group, Instrumentation and Measurement Society, Microwave Theory and Techniques Society, and the Nuclear Science Society.

Papers on any topic of interest to a commission are welcome. In particular, papers on the special topics listed below are solicited. Contact the commission chairperson for further information.

COMMISSION A, Electromagnetic Metrology
Ch.: John D. Norgard, (719) 262-3548
FAX (719) 262-3589
EMAIL j.norgard@ieee.org "

- Microwave to submillimeter measurements/standards
- Quantum metrology and fundamental concepts
- Time and frequency
- Time domain metrology
- EMC and EM pollution
- Noise
- Materials
- Bioeffects and medical applications
- Antenna
- EM-field metrology
- Impulse radar
- Planar structures and microstrip circuits
- Interconnect and packaging
- Ultra-wideband electromagnetic (with B, C)
- Wireless communications (with B, C)
- Advanced materials for EM applications (with B)
- Transient fields, effects, and systems (with B, C)
- Wireless devices and systems (with B, C)

COMMISSION B, Fields and Waves
Ch.: Donald R. Wilton, (713) 743-4442
FAX (71 3) 743-4444
EMAIL wilton@uh.edu

- Antennas
- Arrays
- Complex media effects
- Guided waves
- High frequency techniques
- Interaction and coupling
- Inverse scattering
- Microstrip devices and antennas
- Numerical methods (differential equations)
- Numerical methods (integral equations)
- Numerical techniques (other)
- Rough surfaces and random media
- Scattering
- Theoretical electromagnetic
- Transient fields, effects, and systems (with A, C)
- Wireless devices and systems (with A, C)
- Ultra-wideband electromagnetic (with A, C)
- Wireless communications (with A, C)
- Advanced materials for EM applications (with A)
- Personal, mobile, and cellular communication systems (with C)

COMMISSION C, Signals and Systems
Ch.: David Thomson, (908) 582-6877
FAX (908) 582-2379
EMAIL djt@research. bell-labs.com

- Adaptive beamforming and multisensory arrays
- Signal processing for array feeds
- Wavelets, time-frequency analysis, and modal decomposition
- Signal processing for remote sensing and weather profiling radar
- Spectrum analysis and inverse theory: Detection and estimation
- Personal, mobile, and cellular communication systems (with B)
- Ultra-wideband electromagnetic (with A, B)
- Wireless communications (with A, B)
- Transient fields, effects, and systems (with A, B)
- Wireless devices and systems (with A, B)

COMMISSION D, Electronics and Photonics
Ch: Robert Mattauch, (804) 828-0190
FAX (804) 828-4269
EMAIL rjmattau@saturn.vcu.edu

- Optoelectronic techniques, devices, and materials
- Cryogenic electronic devices and circuits
- Optical transmission and interconnection
- Microwave millimeter wave and submillimeter wave devices& ckts.
- High speed devices and circuits
- Mesoscale devices and associated materials
- Vacuum microelectronics

COMMISSION E, Electromagnetic Noise and
    Interference
Ch: David J. Cohen, (301) 985-4616
FAX (301) 985-4611
EMAIL dcohen@ucsfs1.umd.edu

- Natural and man-made noise
- Communication in the presence of noise
- High-power electromagnetic
- Effects of transients on electronic systems
- EM noise-model developmenf/validation
- Spectrum management and utilization
- Statistical electromagnetics
- Techniques for RFI monitoring, exclusion, and removal (with J)

COMMISSION F, Wave Propagation and
    Remote Sensing
Ch: Wolfhard Vogel, (512) 471-8606
FAX (512) 471-8609
EMAIL wolf_vogel@mail.utexas.edu

- Radar measurements of precipitation
- Remote sensing of the oceans
- Remote sensing of the atmosphere
- Remote sensing of land, ice, and vegetation
- **Terrestrial Propagation Effects (Models and Measurements)**
- **Satellite-Earth Propagation (Models and Measurements)**
- **Indoor Propagation (Models and Measurements)**
- **Mobile Propagation** (Models and Measurements)

COMMISSION G, Ionospheric Radio and Propagation
Ch: Lewis Duncan
Please contact: Vice Ch: **John C. Foster,**
(617) 981-5621

FAX (617) 981-5766
EMAIL jcf@hydra.haystack.edu

- Ionospheric Effects on Radio Propagation and Telecommunication
- Ionospheric Tomography
- Low & Mid-Latitude Radio Studies of the Ionosphere
- Ionospheric Models and Modeling
- Radar Investigations & High-Latitude Studies
- Civilian Uses of GPS (with H)
- HF Ionospheric Modification Research (with H)
- Sprites & Ionospheric Effects of Lightning (with H)
- Radar Techniques Workshop (All day, Friday, Jan. 9)

The Radar Techniques Workshop will focus on technical aspects of ionospheric diagnostics using radar and radiowave techniques. The Workshop is meant to be **a forum for the discussion of recent developments effecting the use and** capabilities of radar instruments and facilities. Participation by the user community **(especially** students using these facilities) is encouraged. Emphasis will be placed on incoherent scatter radar and on recent developments pertaining **to its** use. Related topics dealing with HF or MF radars and digital ionosondes will be considered appropriate. Scientific papers based on radar data should be submitted for presentation in the regular URSI sessions.

COMMISSION H, Waves in Plasma
Ch: Umran Inan, (415) 723-4994
FAX (41 5) 723-9251
EMAIL inan@nova.stanford.edu

- **Waves** in the outer magnetosphere and magnetosheath
- Laboratory simulations of space plasmas
- Wave interjection from space
- Intermediate ionospheric layers
- Mid-latitude turbulent upwellings
- Red sprites, blue jets, and lightning
- Ionospheric modification experiments
- Remote sensing with artificial and natural ELF waves
- Civilian Uses of GPS (with G)
- HF Ionospheric Modification Research (with G)
- Sprites & Ionospheric Effects of Lightning (with G)

COMMISSION J, Radio Astronomy
Ch: Donald Backer, (510) 642-5128
FAX (510) 642-3411
EMAIL dbacker@astro.berkeley.edu

- Probing the Origins of Planetary Systems
- Microwave Photonics in Radio Astronomy
- VLBI Astrometry and Geodesy : Into the New Millennium
- Radio Science in the Classroom
- GHz-Bandwidth Spectrometers & Spectrometers
for Multibeam Instruments
- Techniques for RFI monitoring, exclusion, and removal (with E)

COMMISSION **K,** Electromagnetic in Biology
    and Medicine
Ch: James C. Lin, (312) 413-1052
FAX (312) 413-0024
EMAIL lin@eecs.uic.edu

- Bioelectromagnetic interactions
- Biological effects of RF and ELF fields
- Electromagnetic modeling of biological interactions
- . Wireless technology and health protection
- Medical applications

All abstracts must be received by: **September** 19,1997

Abstracts should be mailed to: Ms. Julie McKie
                                          CIRES
                                          University of Colorado at Boulder
                                          Campus Box 216
                                          Boulder, CO 80309-0216

Questions should be directed to: **Drs. Denise Thorsen (303-492-4290)** *or*
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E-MAIL: infoursi@cires.colorado.edu

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after the Program Committee Meeting,**